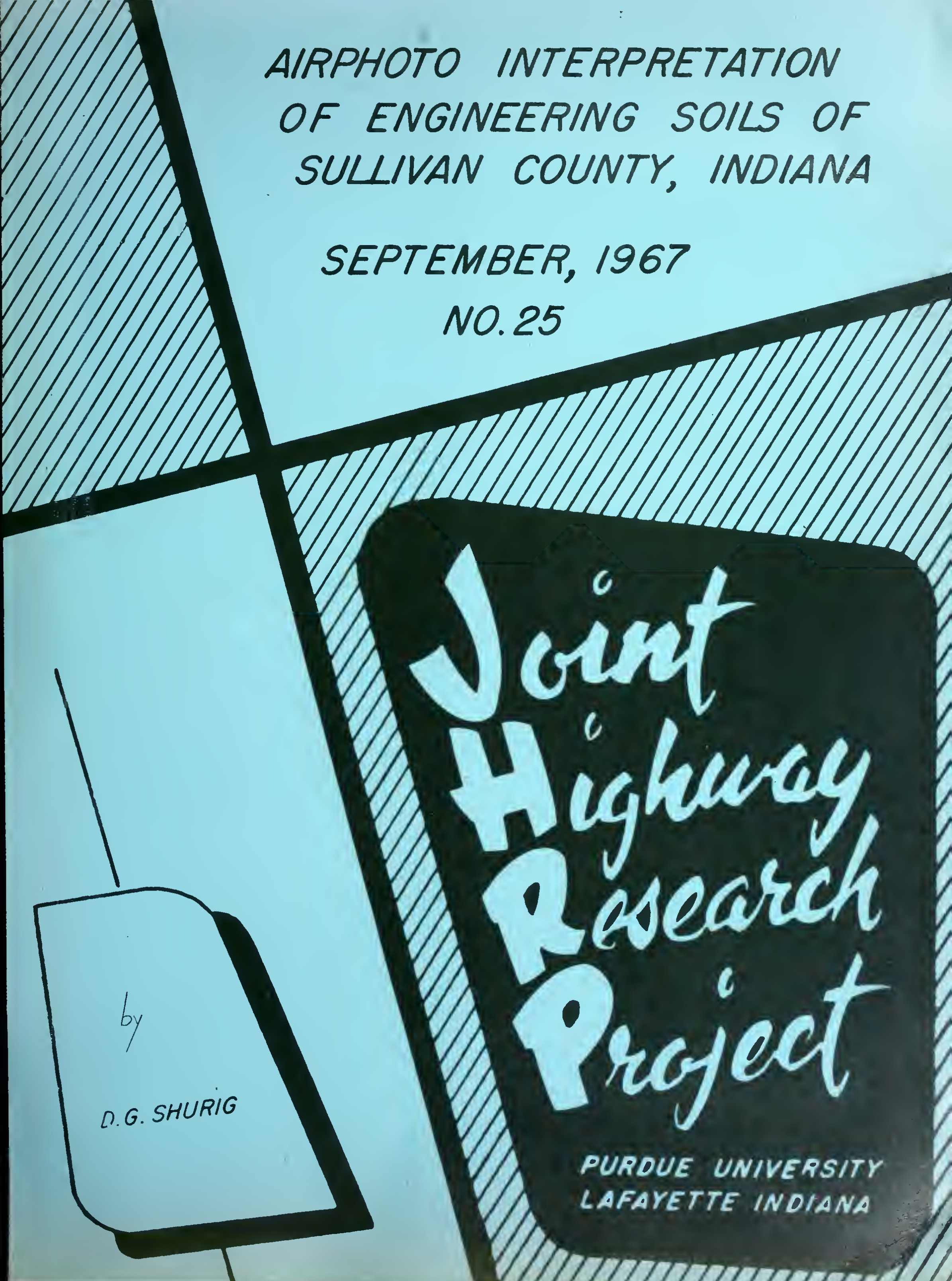
AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF SULLIVAN COUNTY, INDIANA

SEPTEMBER, 1967

NO. 25



by

D. G. SHURIG

Joint Highway Research Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

Final Report

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS OF SULLIVAN COUNTY, INDIANA

TO: Dr. G. A. Leonards, Director
Joint Highway Research Project

September 27, 1967

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

File: 1-2-43
Project: C-36-51B

The attached report, entitled "Airphoto Interpretation of Engineering Soils of Sullivan County, Indiana," completes a portion of the project concerned with development of county engineering soils maps of the State of Indiana. This is the 43rd report in the series. The report was prepared by D. G. Shurig, Research Associate, Joint Highway Research Project.

The soils mapping of Sullivan County was performed primarily by using annotated aerial photographs produced as field surveys by the Soil Conservation Service. Several soil profiles were sampled by the Soil Conservation Service and the Indiana State Highway Commission. Engineering test data on various soil horizons are included in the report. The Engineering Soils Map is presented as a blackline print.

Respectfully submitted,

Harold L. Michael
H. L. Michael
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Final Report

AIRPHOTO INTERPRETATION OF ENGINEERING SOILS
OF
SULLIVAN COUNTY, INDIANA

By
D. G. Shurig
Research Associate

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Project: C-36-51B

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Conducted by

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Engineering Experiment Station
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in cooperation with

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Soil Conservation Service
U. S. Department of Agriculture

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Lafayette, Indiana
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AIRPHOTO INTERPRETATION OF ENGINEERING SOILS

OF

SULLIVAN COUNTY, INDIANA

by

D. G. Shurig

INTRODUCTION

Development of an engineering soils map of Sullivan County (in back-cover pocket of this report) was the primary objective of this project. The purpose of the following report is to supplement the information appearing on the engineering soils map.

The engineering soils map was prepared primarily from pedological soils data. The pedological soils data consisted mainly of annotated aerial photographs which were marked in great detail during a field soil survey of Sullivan County by the United States Department of Agriculture (Soil Conservation Service in cooperation with Purdue University, Agricultural Experiment Station).

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The aerial photographs used to delineate boundaries for the engineering soils map were contact prints 9 by 9 inches or 7 by 9 inches in size. The approximate scale was 1:20,000. The aerial photographs were obtained in 1937. The field agricultural soil survey was performed between 1958 and 1962. Soil names and descriptions were approved in 1966.

Numerical symbols on the annotated photographs indicated soil texture, soil catena, drainage profile, slope class, and erosional class according to USDA classification systems. The catena number, plus the drainage profile number, indicates the soil series. Delineating various individual soil series, and groups of soil series, was the primary technique used in developing parent material boundaries on the engineering soils map.

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The use of pedological data was supplemented with routine airphoto interpretation techniques. Several days were spent in the field verifying judgments pertaining to pedological data and airphoto interpretation.

Field sampling was done by the USDA soil scientists. At each of the 12 sites sampled, samples for laboratory testing were usually taken from the A-, B-, and C-horizons. Due to the obviously bad construction characteristics of muck, peat, marl, and highly organic top soils, these materials were not sampled but were carefully mapped.

All samples were tested by the Joint Highway Research Project, Civil Engineering School, Purdue University. Grain size analysis, Atterburg limits, standard Proctor compaction characteristics, and CBR were determined and the soils classified according to the American Association of State Highway Officials.

The engineering soils map was drawn using graphic symbols to delineate parent materials (grouped according to landform and origin). Textural symbols were superimposed on the parent material symbols to indicate relative composition of the parent material soils. The map also carries a set of soil profiles showing the general soil profile of topographic high and low sites in each parent material area. Each profile shows the general range in depth and range in soil textures (ISHC soil textures) of each soil horizon.

DESCRIPTION OF AREA

General

Sullivan County is located in the southwestern part of Indiana along the Wabash River (Fig. 1). It has a north-south length of 24 miles and an east-west width averaging 18 miles. The total area is 457 square miles. Sullivan, the county seat in the center of the county, is 85 miles southwest of Indianapolis.

In 1960 the total population of the county was 21,721. About 52 percent of the population is rural and 48 percent urban (5). Agriculture is the main source of income and corn and soybeans are the main crops. Orchards and watermelon patches are numerous in sand dune areas adjacent to the river. Livestock are raised in considerable quantities for meat and dairy products. In the east, coal mining by stripping methods is a significant industry.

Drainage Features

A small portion of the northeast corner and a slightly larger area in the southeast corner of the county is in the White River drainage basin. The remainder of the county is in the Wabash River basin.

The Wabash flows in a preglacial valley-the river served as a sluiceway during glacial times. Busseron Creek, the largest tributary, drains the notheastern half of the central area and the southwestern corner of the county. Turtle and Turman Creeks and Rogers Ditch drain the northwest and western portions. The extreme southern and southeastern portion of the county drains mainly into Meriah Creek and Pollard Ditch.

The Wabash River is bordered by broad bottoms that are subject to occasional flooding, however, almost all of these areas have been protected from severe flooding by levees. The Wabash River flows against the old valley wall at Merom and at the Narrows.

Ditches have been constructed to improve sluggish drainage conditions in low-lying and nearly level sections. An example is the dridging of the lower reaches of Busseron Creek, this stream now flows through an artifical channel to the Wabash River.

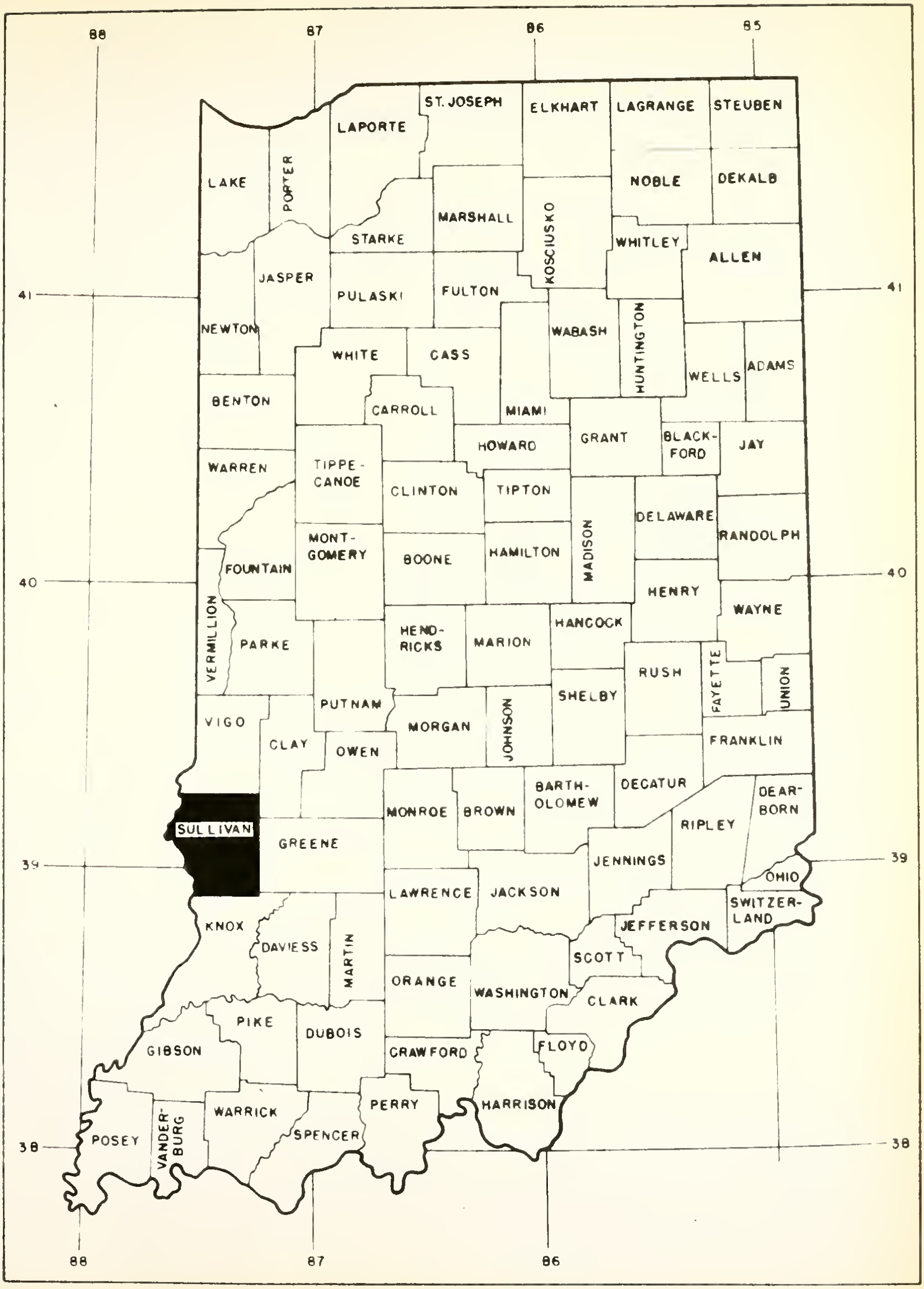

FIG.1 LOCATION MAP OF SULLIVAN COUNTY

Although there are no natural lakes in Sullivan County there are several bayous resulting from abandoned meanders in the Wabash Valley. A cut-off meander of the Wabash River in the southeast border of the county, has isolated a small part of the State of Illinois on the Indiana side of the Wabash.

Water-filled strip mines and gravel pits, as well as ponds of various origins are scattered over the county. The courses of the natural drainage ways have been disrupted by strip mining operations in the eastern part of the county.

Natural drainage is perhaps best developed in the uplands adjacent to the principal streams. Most of the larger streams have cut into bedrock and the depth to bedrock is often quite shallow near the streams. Drainage patterns are fine textured deditic or rectangular type in the dissected uplands. Low gradient gullies extend long distances into the uplands in the central part of the county.

Climate

The climate of Sullivan County is continental, humid, and temperate. Temperature varies greatly from winter to summer but precipatation is relatively uniform the year around.

The weather data listed in Table I comes from 51 years of data on file at the weather station in Farmersburg. Though Farmersburg is on the north central county line it is expected that the data is representative for the entire county.

Physiography

Sullivan County lies within the Wabash Lowland physiographic region of the State. In relation to the United States, the county is located in the Till Plains section of the Central Lowland province (2).

TABLE 1

AVERAGES AND EXTREMES OF TEMPERATURE AND PRECIPITATION

AT FARMERSBURG, INDIANA

Month	Temperature			Precipitation		
	Average °F	Absolute Maximum °F	Absolute Minimum °F	Average inches	1 in 10 yr. less than	1 in 10 yr. more than
January	31	77	-24	2.7	0.7	7.3
February	33	75	-23	1.9	0.5	3.6
March	43	88	- 5	3.4	1.4	7.0
April	53	88	21	3.3	1.7	6.3
May	64	96	20	4.6	1.3	8.9
June	72	104	39	4.0	1.6	7.5
July	77	111	46	2.9	1.0	5.6
August	75	106	41	3.4	1.0	6.4
September	69	105	21	3.7	1.0	6.3
October	57	93	19	2.9	0.7	5.7
November	44	90	- 4	2.6	1.1	4.6
December	33	71	-19	2.4	0.7	4.7
Year	54	111	-24	37.8	28.7	46.3

Reference (1)

Topography

The county, as a whole, is relatively flat. The surface of the county is that of an Illinoian glacial plain. Primary breaks in the surface are caused by the wide flat valleys of the Wabash River and it's tributaries. The generally flat surface has also been quite highly dissected by numerous small streams, strip mining, and erosion. A belt of sand dunes up to several miles wide has produced some low rolling hills adjacent to the Wabash River valley.

General elevations for the entire county are shown in Figure 2. The lowest elevation is 420 feet and occurs where the natural channel of Busseron Creek enters Knox County on the south. The highest point, 640 feet, is located southwest of Sullivan. Other high points, that are over 600 feet in elevation are located in the northeast part of the county. The elevation of the surface north and west of Sullivan is about 540 feet.

The Wabash River valley ranges from one to five miles wide. The northern two-thirds of the valley is essentially floodplain as there are only a few small low terraces. The southern third, however, has wide terraces up to several miles wide, with some sand dunes and low slack water basins. The valley wall of interbedded sandstone and shale ranges from high and precipitous to low and gently sloping. At Merom a sandstone bluff rises 170 feet above the river. Most of the valley wall, however, rises less than 50 feet above the terraces.

A belt of sand dunes up to several miles wide along the Wabash Valley forms an area of low rolling hills with an average relief of 20 feet and a maximum of about 40 or 50 feet. The uplands, from the dunes to the east, are primarily gently undulating loess covered plains. Along the eastern border are numerous coal strippings and waste piles ranging from 20 to 30 feet deep and 20 to 30 feet high respectively.

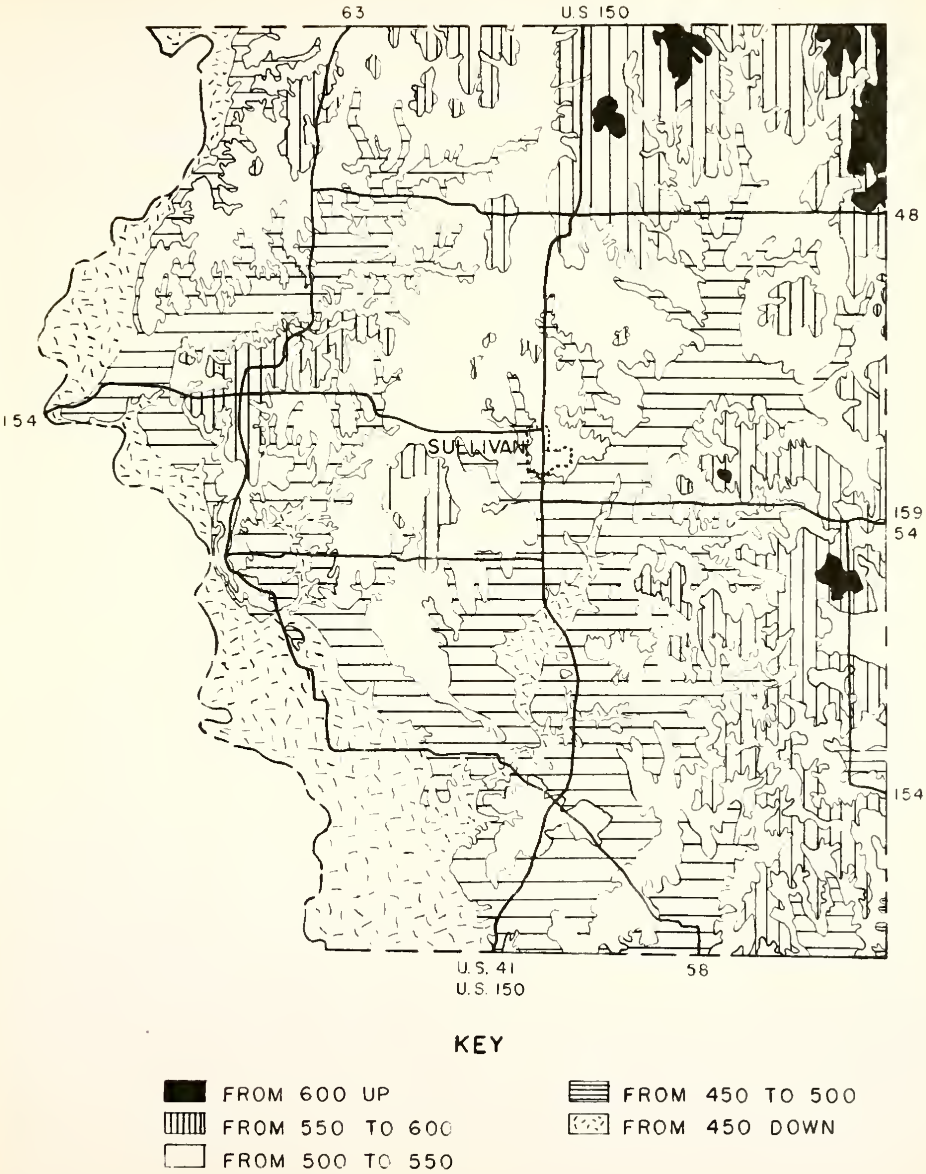

FIG. 2 TOPOGRAPHIC MAP OF SULLIVAN CO.

(CONTOUR INTERVAL 50')

Along the major tributaries to the Wabash River are some wide, flat lacustrine plains one or two miles wide and several miles long. Small streams have cut channels five to ten feet into the lacustrine plains.

Geology

Essentially all the surface materials are unconsolidated glacial materials of the Illinoian and Wisconsin glacial periods. The uplands are primarily Illinoian tills with a loess cover; an exception is the belt of sand dunes along the Wabash River. Most of the lowlands consist of Wisconsin valley train outwash soils and a lesser amount of lacustrine soils.

Generally the loess and Illinoian drift are thinest in the eastern part of the county. The thin cover is reason for most of the coal strip mines being located on the eastern side of the county. The loess and drift together may range from a depth of several feet in the east to over a 100 feet, in places, in the west. Most of the county, however, has a cover of unconsolidated material ranging from 10 feet to 50 feet (1,2).

The major tributaries to the Wabash River contain lacustrine plains in wide, flat valleys. The valleys are much too wide for the size of the present streams. The big valleys were curved when streams carried great volumes of meltwater. Wabash River deposits may have dammed the mouths of these streams to cause the formation of lakes and lake deposits in the wide valleys. With subsidence of the meltwaters and erosion of the valley dams, smaller streams began to flow again in the valleys. The smaller streams flowed across the lacustrine plains, then cut into them and later deposited narrow bands of alluvium across the lacustrine plains.

Under the unconsolidated glacial materials are the Pennsylvanian coal measures. They consist of interbedded shale, sandstone, coal, fire clay and some limestone. The limestones are relatively thin and clayey. Good limestone, for construction purposes, seldom occurs close to the ground surface. One very large limestone quarry is noted on the soils map in the southeastern part of the county.

Coal has been mined by shaft and open pit mining; the latter method is used extensively in the eastern part of the county. Many of the waste piles from strippings have been reforested.

"Sullivan County probably contains all the coals to Coal IX. Deep well records show the presence of coals which probably correspond to most of the lower coals. Coal IV is the lowest coal outcropping in the county. It outcrops along the eastern edge of the county. Coal VI outcrops about ¼ to ½ mile west of the outcrop of Coal V. Coal VII occurs almost to the eastern border of the county along the south line but lies west of Busseron Creek farther north. Coal VIII has a workable thickness near Merom in the western part of the county (2).

When planning for a major highway, or structure, the engineer in charge should consult a recent publication "Ground-Water Resources of West-Central Indiana--Preliminary Report: Sullivan County" (4).

This report contains the descriptions of many hundreds of water wells. The depth of casting usually indicates the approximate depth or bedrock. The casing is most often sealed a few inches or feet into weathered bedrock.

Glacial Deposited Materials

Essentially all the soils of Sullivan County are of glacial origin. The overall flat surface of the county can be attributed to Illinoian till plain materials. Wisconsin glaciation covered these with aeolian deposits of loess and windblown sand. Wisconsin glaciation also produced alluvial plain soils, terrace soils, lacustrine plain soils and peat and muck deposits.

1. Deep Loess on Illinoian Till Plains

The greatest area of the county is covered with a blanket of loess about 12 feet thick. The underlying material is clayey Illinoian till followed by the coal measures.

The wide band of thick loess extends from the north central county line to the southeast corner of the county. The width of the band in the northern half of the county is two to three times that in the southern half.

Though the average depth of the loess over most of the area is 12 feet, it may range from two or three feet to over 25 feet in thickness. The general trend is a decrease in thickness from west to east.

The deep loess area was sampled at nine sites. The site locations are designated on the attached map and numbered as follows: one, and five through 12 inclusive, Appendix A shows the results of soil classification from each of these sites. In general, the loess classifies as a silty loam or as a silty clay loam.

2. Illinoian Till Plain with Loess Mantle (3 to 5 ft.)

To the east of the deep loess area, described above, is an area where the average loess depth is three to five feet thick. The three-to five-foot loess area forms a transition zone between deep loess, to the west, and areas where loess mainly constitutes the topsoil, somewhere beyond the eastern boundary of Sullivan County.

Though the average loess thickness for the area is three to five feet the range is from zero to five feet. The shallower areas are usually on slopes near streams and gullies. The loess has a fragipan at a depth of two to three feet and it is two to three feet thick (1).

The results of soil tests for three sites are shown in Appendix A. Sample sites are numbered: 2, 3, and 4 in Appendix A and on the map. The parent material at each of these three sites classified as a low plastic clay.

3. Sand Dunes

The sand dune area is the third largest landform-parent material area in the county. It forms a belt one half mile to three miles wide along the east side of the Wabash River Valley. There are also a number of sand dunes on the river terraces and floodplains.

While the materials of the sand dune areas are predominantly fine, uniform, windblown sands, a good deal of silt and clay particles were also blown and mixed with the fine sands. Lateral and vertical changes of soil types in the dune areas can be quite variable. The surface soils are usually fine sandy loams and loamy fine sands but very frequently they are loams, silt loams and clay loams. The B-horizon is occasionally a sandy clay or sandy clay loam. The C-horizon is most often fine sands with bands of loamy fine sand or silt.

The sand dunes on the floodplain and terraces are relatively low with a relief seldom over ten feet. The floodplain dunes are underlain with stratified silts and sands and the terrace dunes usually with stratified sands and gravels. The upland dunes have a relief ranging from five feet to 40 feet and generally overlie the clayey Illinoian till.

4. Lacustrine Plains

All the lacustrine plains in Sullivan County are located in the western half of the county adjacent to streams. The lacustrine soils were deposited in lakes formed by the damming of streams or in lakes formed by slackwater.

The largest lacustrine plain, about a mile and a half by four miles, lies along Busseron Creek, three miles south of the City of Sullivan. A lacustrine plain, one mile by six miles, along Turman Creek, has been somewhat dissected by that stream. In the southwest part of the county, on a large Wabash River terrace, is a lacustrine plain about one by two miles. It was formed in a slack water area and has a highly organic top soil. Other smaller lake plains can be noted in the southwest part of the county.

Because of the addition of considerable silt and fine sand, the Sullivan County lacustrine clays are less plastic than most lake clays. The parent materials of lacustrine plains along the Wabash are composed of stratified, moderately plastic clay, lean clays and sandy clays. At least one has highly organic top soil.

In the large lake plains, trending east-west along the major streams, it appears that the lacustrine parent materials are more clayey toward the mouth of the streams and grade more silty and sandy upstream.

5. Terraces

Gravelly textured terraces

Several large gravelly terraces, each ranging from one to three or four square miles in size are located in southwestern Sullivan County just east of the Wabash River Floodplain. Another, about one square mile in area, is located on the Wabash at the mouth of Turman Creek. There

are also several small gravelly terrace areas near the northern county line.

The gravelly parent material usually has two to four feet of loam to sandy loam cover. Composition of the parent material may range from 20 to 60 percent gravel, 30 to 80 percent sand and 0 to 10 percent fines.

Sandy Textured Terraces

The more sandy textured terraces are generally located east of the gravelly textured terraces or farther from the Wabash River floodplain.

The sandy parent material is usually covered with a sandy loam or with a loam or silty clay from three to five feet thick. The parent material is stratified sand with thin lenses of gravel. The general composition ranges from 0 to 30 percent gravel, 60 to 95 percent sand and 0 to 30 percent fines.

Silty and sandy terraces

In some large terrace depressions, and depressions in the uplands adjacent to the terraces, stratified materials have been deposited. Parent material ranges from stratified loam and fine sand in some places to stratified silt, sand and some clay and gravel in other places. Most surface soils are a very dark gray indicating a fairly high organic content.

6. Alluvial Plains

Sandy Textured Alluvium

Sullivan County has a relatively large amount of floodplain area along the rivers and streams. The floodplain along the Wabash River is in places, two miles wide. The parent material is more sandy along streams in the uplands. The parent materials are primarily stratified sandy loams, silt loams and loams. Surface and subsurface soils are most often silty loams, clay loams and sandy loams. The lateral and vertical variation of soil types in the river alluvium is quite variable.

Silty Textured Alluvium

The larger tributary streams of the Wabash have over-sized alluvial plains. The soils are mainly silt loams and silty clay loams. Most of this material was washed in from the surrounding loess-covered uplands.

The alluvial plains in the eastern part of the county, where there is shallow loess and Illinoian till, have cut into sedimentary rock more often than in the central part of the county where the loess is deeper. As a result the alluvial soil in the east are somewhat more sandy than those in the west. The alluvial plains on the east may contain thin sand lenses while the central alluvial plains may show thin layers of clay loam, silt loam, sandy loam, sandy clay and sandy clay loam.

7. Miscellaneous

Illinoian Till on Bedrock

In the northwest corner of the county, there is a sloping escarpment, 1/4 to 3/4 mile wide between the floodplain and the sand dune covered upland. This narrow escarpment has one to three feet of Illinoian till over interbedded sandstone and shale bedrock.

This land occupies steeply and very steeply sloping ravines and cliff faces. It is in the western part of the county beginning at Merom and extends northward in a long narrow band beyond the county line.

This land consists of 12-30 inches of stony loam or silt loam soil over clay shale or sandstone bedrock. Sandstone and shale outcrops are present in a number of places. Included are small bodies of stony soils. Numerous gullies and draws exposing sandstone and shale are present.

Muck and peat

Sullivan County contains a relatively small amount of muck and peat. Small shallow deposits occupy depressions in terraces along the Wabash River adjacent to the uplands in the vicinities of Merom Station and northwest of Graysville. The latter were too small to map.

Muck usually is found to a depth of about two feet but it occassionally extends to 30 or 36 inches where peat is encountered.

Strip Mines

In the eastern part of the county are numerous coal strip mines. The strip mine areas indicated on the attached engineering soils map include both the pit area and the spoil material area. The spoil was most frequently dumped in elongated piles and consists of a heterogeneous mixture of soil materials, sandstone boulders and slabs, shale chunks and some coal. Some of the spoil banks have been reforested and some have not. Some pits contain water and some are dry.

Some of the strippings have been subsequently widened, therefore, some representative areas on the map may be too small. Several new sites have also been opened. Field investigation of these areas is required.

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Site No.	Horizon	Depth, Ft.	CBR (Surcharge 35 lb.)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
	A_2	1/4-11/12	1	22.0	CL	A-4(8)
1	B_{22}	2-5/12-3-3/4	7	17.8	CL	A-7-6(13)
	C_1	4-1/6 - 6-7/12$^+$	-	--	CL	A-6(9)
	A_{21}	3/4 - 1-2/3	4	16.6	CL	A-6(8)
2	B_{22m}	2-3/4 - 3-11/12	8	17.9	CL	A-7(18)
	C	5 - 6-2/3	6	13.9	CL	A-6(10)
	A_{21}	1/2 - 1-1/2	7	17.8	CL	A-4(8)
3	B_{22m}	2-1/6 - 3-1/2	8	8	CL	A-7-6(15)
	C	4-1/12 - 5-1/6	4	13.5	CL	A-6([illegible])
	A_{21}	2/3 - 1-1/2	5	16.6	CL	A-4(8)
4	B_{22m}	2-[illegible]/4 - 3-3/4	5	21.8	CH	A-7-5(18)
	C	4-[illegible]/3 - [illegible]/3	5	13.8	CL	A-6(11)
	A_2	7/12 - 11/12	3	17.9	CL	A-6([illegible])
5	B_{22}	2-1/4 - 3-1/4	-	--	CL	A-7(12)
	C	4-1/12 - 4-11/12$^+$	-	--	CL	A-4(8)
	A_p	0 - 3/4	2	24.0	OL	A-6(10)
6	B_{22g}	2-5/6 - 4-5/6	6	18.6	CH	A-7-6(20)
	C_g	4-5/6 - 5-5/6$^+$	6	17.4	CL	A-7-6(15)
	A_2	2/3 - 1-1/6	-	--	CL	A-6(8)
7	B_{21g}	1-3/4 - 2-2/3	7	21.7	CH	A-7-6(19)
	C	3-1/3 - 5$^+$	6	15.0	CL	A-6(11)

APPENDIX A
SOIL TEST DATA FOR SULLIVAN COUNTY

Site No.	Horizon	Depth, Ft.	Grain Size Distribution: Gravel Greater Than #4 %	Grain Size Distribution: Fine Gravel #4-#10 %	Grain Size Distribution: Coarse Sand #10-#40 %	Grain Size Distribution: Fine Sand #40-#200 %	Grain Size Distribution: Silt #200-0.005 mm. %	Grain Size Distribution: Clay Less Than .005 mm. %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Standard Laboratory Compaction (AASHO T99): Max. Dry Weight pcf	CBR (Surcharge 35 lb.)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
	A_2	1/4-11/12	0	0	1	8	63	28	30	10	22.0	99.8	1	22.0	CL	A-4(8)
1	B_{22}	2-5/12-3-3/4	0	0	0	10	55	35	40	22	18.5	106.4	7	17.8	CL	A-7-6(13)
	C_1	4-1/6 - 6-7/12$^+$	0	0	0	7	70	23	31	11	15.9	111.7	-	--	CL	A-6(9)
	A_{21}	3/4 - 1-2/3	0	1	4	10	53	32	29	10	17.8	108.1	4	16.6	CL	A-6(8)
2	B_{22m}	2-3/4 - 3-11/12	0	0	4	8	46	42	48	31	18.6	105.5	8	17.9	CL	A-7(18)
	C	5 - 6-2/3	0.5	0.3	7.2	32	31	29	34	23	14.2	115.7	6	13.9	CL	A-6(10)
	A_{21}	1/2 - 1-1/3	0	2	4	8	62	22	30	9	17.8	108.1	7	17.8	CL	A-4(8)
3	B_{22m}	2-1/6 - 3-1/2	0	0	5	5	51	39	44	24	19.7	104.4	8	8	CL	A-7-6(15)
	C	4-1/12 - 5-1/6	0	2	4	24	43	27	26	13	13.3	118.2	4	13.5	CL	A-6(8)
	A_{21}	2/3 - 1-1/2	0	0	5	11	56	28	28	10	17.8	108.1	5	16.6	CL	A-4(8)
4	B_{22m}	2-3/4 - 3-3/4	0	0	2	9	45	44	51	32	22.0	99.2	5	21.8	CH	A-7-5(18)
	C	4-2/3 - 6-2/3	0	0	2	21	47	30	33	17	14.4	115.1	5	13.8	CL	A-6(11)
	A_2	7/12 - 11/12	0	0	0	5	66	29	31	11	18.7	106.2	8	17.9	CL	A-6(8)
5	B_{22}	2-1/4 - 3-1/4	0	0	0	3	61	36	43	20	19.3	105.9	-	--	CL	A-7(13)
	C	4-1/12 - 4-11/12$^+$	0	0	1	14	59	26	27	9	14.2	115.7	-	--	CL	A-4(8)
	A_p	0 - 3/4	0.2	0.1	1.7	2	61	35	40	16	24.2	96.7	2	24.0	OL	A-6(10)
6	B_{22g}	3-5/6 - 4-5/6	0	0	2	4	49	45	58	32	19.8	104.2	6	18.6	CH	A-7-6(20)
	C_g	4-5/6 - 5-5/6$^+$	0	0	1	4	60	35	46	26	17.8	108.1	6	17.4	CL	A-7-6(15)
	A_2	2/3 - 1-1/6	0	0	6	6	58	30	33	11	18.4	106.9	-	--	CL	A-6(8)
7	B_{21g}	1-3/4 - 2-2/3	0	0	2	2	54	42	54	33	21.9	100.1	7	21.7	CH	A-7-6(19)
	C	3-1/3 - 5$^+$	0	0	1	7	66	26	33	18	15.4	112.9	6	15.0	CL	A-6(11)

			ion			
Site No.	Hori-zon	Depth, Ft.	CBR (Surcharge 35 lb.)	Molded Moisture Content for CBR Test	Unified Class-ification	AASHO Class-ification
	A_p	0 - 3/4	8	18.4	OL	A-4(8)
8	B_{21g}	1-5/6 - 3-7/12	6	20.6	CH	A-7-6(19)
	C_g	5 - 5-5/6$^+$	8	14.4	CL	A-6(11)
	A_p	0 - 3/4	5	19.1	OL	A-6(8)
9	B_{22g}	2 - 4-1/6	8	18.3	CL	A-7-6(12)
	C_g	4-1/6 - 5$^+$	-	--	CL	A-6(10)
	A_p	0 - 7/12	4	19.6	OL	A-4(8)
10	B_{22}	1-11/12 - 3	-	--	ML-CL	A-7-6(13)
	C	4-5/12 - 5-1/4$^+$	9	15.7	CL	A-6(10)
	A_p	0 - 3/4	[illegible]	21.4	ML-CL	A-6(8)
11	B_{1g}	[illegible]	6	19.[illegible]	CL	A-7-6(14)
	C	3-1/3 - 4-1/6	6	13.6	CL	A-6(10)
	A_p	0 - 3/4	-	--	ML-CL	A-4(8)
12	B_{21g}	[illegible]-1/6 - 3-1/12	5	[illegible]	CL	A-7-6([illegible])
	C	4-1/3 - 5-5/12	4	17.9	CL	A-7-6(15)

APPENDIX A (Continued)
SOIL TEST DATA FOR SULLIVAN COUNTY

Site No.	Horizon	Depth, Ft.	Grain Size Distribution: Gravel Greater Than #4 %	Fine Gravel #4-#10 %	Coarse Sand #10-#40 %	Fine Sand #40-#200 %	Silt #200-0.005 mm %	Clay Less Than 0.005 mm %	Liquid Limit %	Plastic Index %	Standard Laboratory Compaction (AASHO T99): O.M.C. %	Max. Dry Weight pcf	CBR (Surcharge 35 lb.)	Molded Moisture Content for CBR Test	Unified Classification	AASHO Classification
8	A_p	0 - 3/4	0	0	2	11	62	25	32	10	19.1	105.5	8	18.4	OL	A-4(8)
	B_{21g}	1-5/6 - 3-7/12	0	0	3	3	49	45	54	35	21.3	100.4	6	20.6	CH	A-7-6(19)
	C_g	5 - 5-5/6$^+$	0	0	4	17	49	30	35	17	15.3	115.5	8	14.4	CL	A-6(11)
9	A_p	0 - 3/4	0	1	2	7	68	22	31	11	19.7	104.4	5	19.1	OL	A-6(8)
	B_{22g}	2 - 4-1/6	0	0	2	5	63	30	41	21	18.2	108.3	8	18.3	CL	A-7-6(12)
	C_g	4-1/6 - 5$^+$	0	0	1	6	71	22	34	14	6.5	110.5	-	--	CL	A-6(10)
10	A_p	0 - 7/12	0	0	2	8	67	23	30	8	20.5	102.4	4	19.6	OL	A-4(8)
	B_{22}	1-11/12 - 3	0	0	0	4	60	36	44	19	20.1	103.4	-	--	ML-CL	A-7-6(13)
	C	4-5/12 - 5-1/4$^+$	0	0	2	11	60	27	34	15	15.9	111.7	9	15.7	CL	A-6(10)
11	A_p	0 - 3/4	0	0	3	7	60	30	34	11	21.5	100.6	2	21.4	ML-CL	A-6(8)
	B_{1g}	1 - 1-5/12	0	0	2	8	55	35	45	23	20.5	102.4	6	19.9	CL	A-7-6(14)
	C	3-1/3 - 4-1/6	0	0	4	21	47	28	37	22	15.1	113.7	6	13.6	CL	A-6(13)
12	A_p	0 - 3/4	0	1	3	12	60	24	26	6	14.9	114.8	-	--	ML-CL	A-4(8)
	B_{21g}	[illegible]-1/6 - 3-1/12	0	0	2	10	48	40	49	30	19.4	104.9	5	19.8	CL	A-7-6(18)
	C	4-1/3 - 5-5/12	0	1	3	16	45	35	42	27	17.8	108.1	4	17.9	CL	A-7-6(15)

JHRP 67/25

JHRP 67/25

LEGEND

PARENT MATERIALS (GROUPED ACCORDING TO LAND FORM AND ORIGIN)

- LOESS ON ILLINOIAN TILL PLAIN
- ILLINOIAN TILL PLAIN WITH LOESS MANTLE (<6')
- THIN ILLINOIAN DRIFT OVER INTERBEDDED SANDSTONE - SHALE
- SAND DUNES
- TERRACE
- LACUSTRINE PLAIN
- ALLUVIAL PLAIN
- PEAT AND MUCK

MISCELLANEOUS

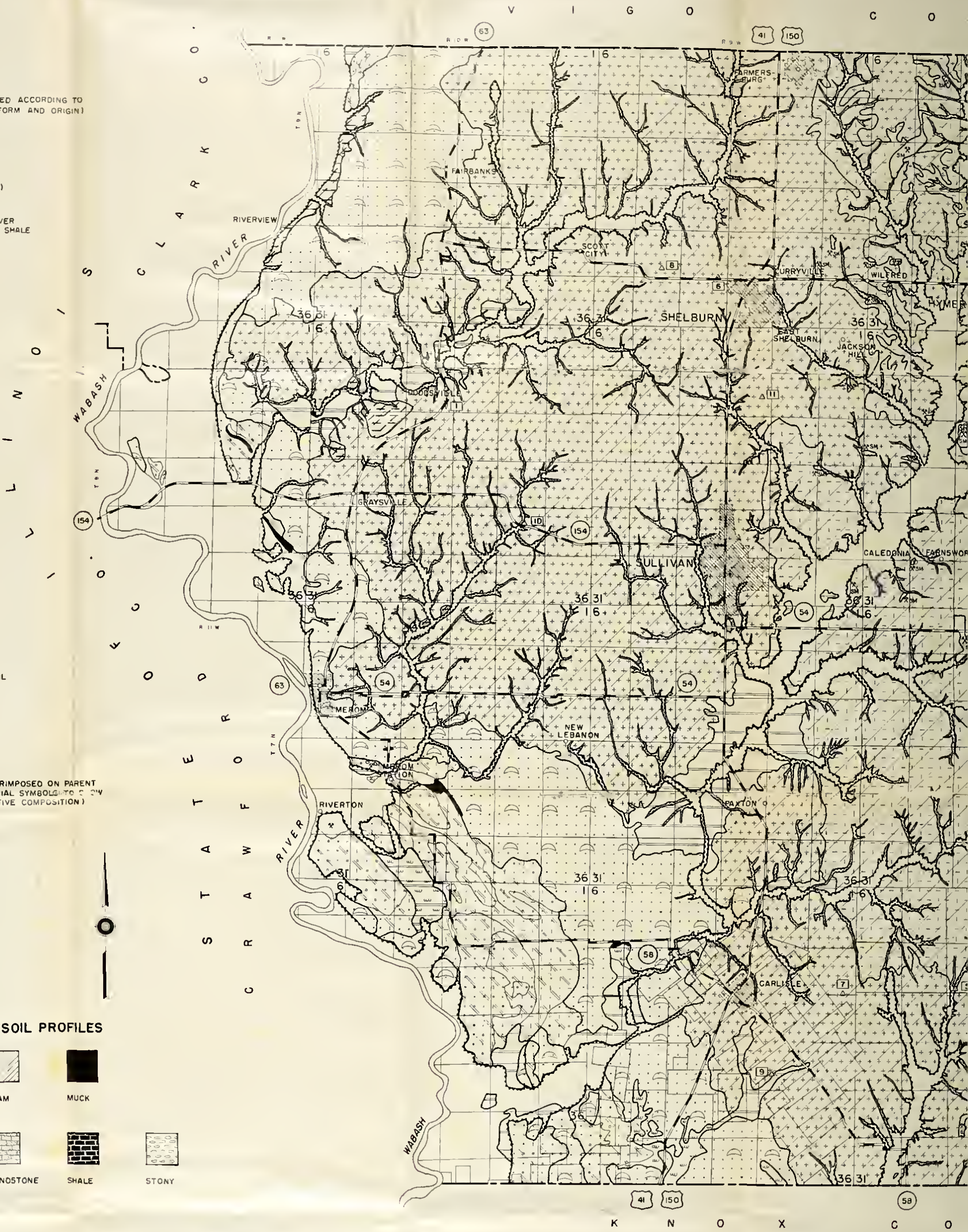
- STRIP MINE
- STONE QUARRY
- GRAVEL PIT
- HIGHLY ORGANIC TOP SOIL
- SOIL SAMPLING SITE

TEXTURAL SYMBOLS (SUPERIMPOSED ON PARENT MATERIAL SYMBOLS TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

TEXTURAL SYMBOLS FOR SOIL PROFILES

- SILT
- CLAY
- LOAM
- MUCK
- SAND
- GRAVEL
- SANDSTONE
- SHALE
- STONY

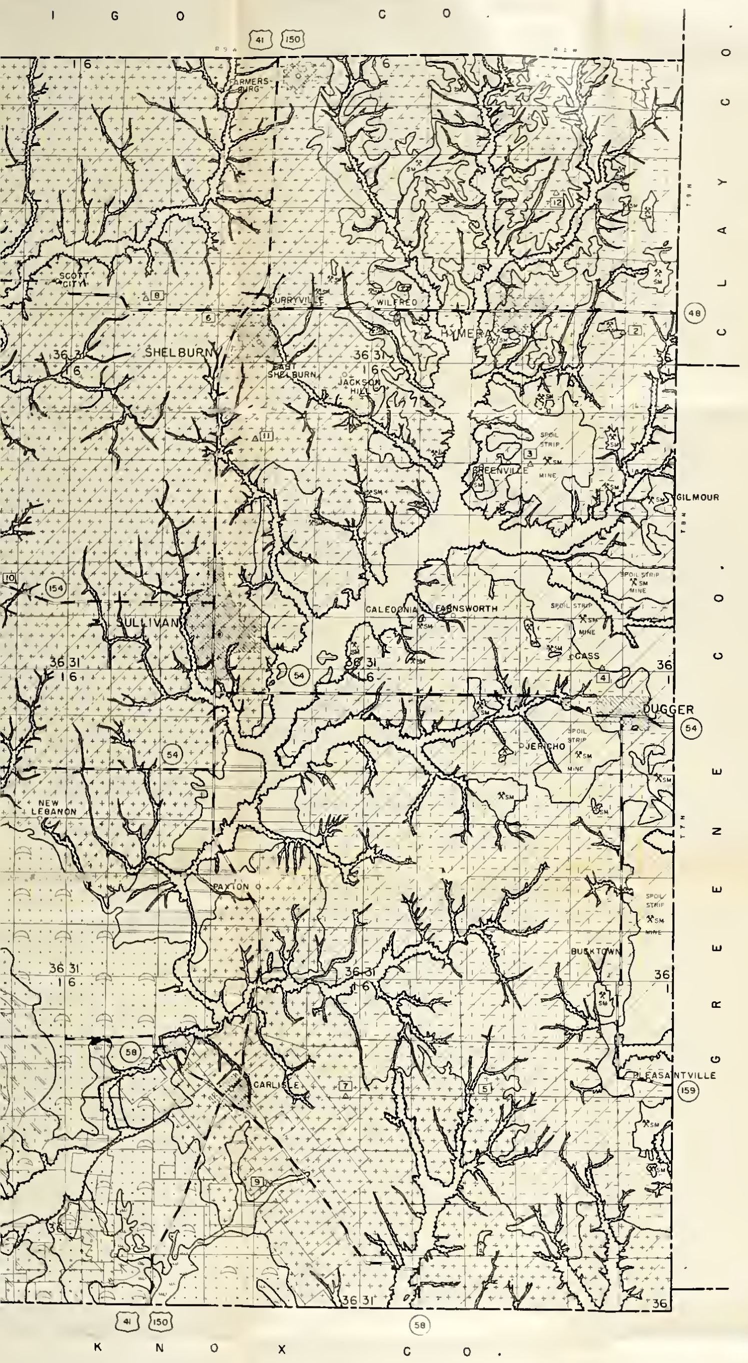


ENGINEERING SOILS MAP
SULLIVAN COUNTY
INDIANA

PREPARED FROM
1937 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY

SCALE OF MILES
$\frac{3}{4}$ $\frac{1}{2}$ $\frac{1}{4}$ 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF: D.G. SHURIG



ENGINEERING SOILS MAP

SULLIVAN COUNTY

INDIANA

PREPARED FROM
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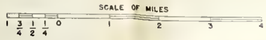
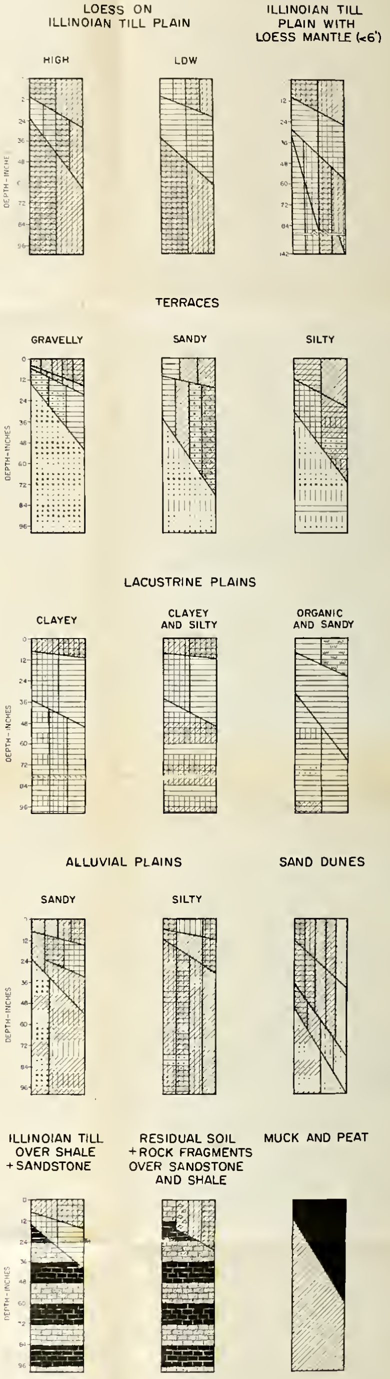


POLYCONIC PROJECTION

GENERAL SOIL PROFILES



DRAWN BY: Y.K. TANG AND T.Z. HALBO